

I CLAIM:

1. Apparatus for applying a coating of positive ions to a substrate having a coating area to be coated, the apparatus comprising:

- a) a vacuum chamber;
- b) a holder in the vacuum chamber for supporting the substrate;
- c) a filtered cathodic arc source for directing a plasma beam

containing the positive ions toward the substrate, the plasma beam having a cross-sectional beam area on the substrate which is smaller than the coating area on the substrate; and

d) scanning means for moving the beam in a raster scan across the substrate to coat the coating area.

2. The apparatus of claim 1, wherein the scanning means is operative for moving the beam along two mutually orthogonal directions in a scan pattern.

3. The apparatus of claim 1, wherein the holder is a rotary drum for moving the substrate relative to the beam.

4. The apparatus of claim 3, wherein the substrate is mounted on a peripheral surface of the drum.

5. The apparatus of claim 1, wherein the holder is movable, and further comprising a plurality of additional substrates mounted on the movable holder.

6. The apparatus of claim 2, wherein the scanning means is operative for generating a magnetic field for moving the beam at one scanning frequency in one of the directions, and at another scanning frequency in the other of the directions.

7. The apparatus of claim 6, wherein each scanning frequency lies in a range of 2-100 Hz.

8. The apparatus of claim 1; and further comprising an additional filtered cathodic arc source for directing an additional plasma beam toward the substrate, the additional plasma beam having a cross-sectional additional beam area on the substrate

which is smaller than the coating area on the substrate; and an additional scanning means for moving the additional beam in a raster scan across the coating to coat the coating area on the substrate with an additional coating.

9. The apparatus of claim 1, wherein the cathodic arc source includes an interchangeable cathode.

10. The apparatus of claim 1; and further comprising means for applying an electrical bias to the substrate.

11. The apparatus of claim 10, wherein the bias is a DC voltage.

12. The apparatus of claim 10, wherein the bias is an RF signal.

13. The apparatus of claim 1, wherein the cathodic arc source includes a duct having two bends.

14. The apparatus of claim 13, wherein one of the bends lies in a first plane, and the other of the bends lies in a second plane, and wherein the planes are not co-incident.

15. The apparatus of claim 1, wherein the substrate is a dielectric substrate; said apparatus further comprising means for applying a radio frequency bias to the dielectric substrate to dissipate electrostatic charge accruing during coating of the coated area.

16. The apparatus of claim 15, wherein the dielectric substrate is an optical element.

17. Apparatus for applying a coating of positive ions to a plurality of substrates each substrate having a coating area to be coated, the apparatus comprising:

- a) a vacuum chamber;
- b) a holder in the vacuum chamber for supporting the plurality of substrates;

- c) a plurality of filtered cathodic arc sources for directing respective plasma beams each containing the positive ions towards the substrates, each plasma beam having a cross-sectional beam area on a respective substrate which is smaller than a respective coating area on the respective substrate;
- d) scanning means for moving the beams in respective raster scans across the substrates to coat the respective coating areas of the substrates; and
- e) drive means for moving the holder relative to the beams.

18. The apparatus of claim 17, wherein the plurality of arc sources are simultaneously operated.

19: Apparatus for applying a coating of positive ions to a substrate having a coating area to be coated, the apparatus comprising:

- a) a vacuum chamber;
- b) a holder in the vacuum chamber for supporting the substrate;
- c) a filtered cathodic arc source for directing a plasma beam containing the positive ions toward the substrate, the plasma beam having a cross-sectional beam area on the substrate which is smaller than the coating area on the substrate;
- d) scanning means for moving the beam in a raster scan across the substrate to coat the coating area on the substrate; and
- e) drive means for moving the holder relative to the beam.

20. Apparatus for applying a coating of positive ions to a substrate having a coating area to be coated, the apparatus comprising:

- a) a vacuum chamber;
- b) a holder in the vacuum chamber for supporting the substrate;
- c) a cathode arc source for directing a plasma beam containing the positive ions towards the substrate; and
- d) scanning means;

wherein the scanning means comprises means for scanning the beam in a y-axis and means for scanning the beam in an x-axis across the substrate to coat the coating area.

21. The apparatus according to claim 20, wherein the scanning means is operative for generating magnetic fields for moving the beam at a scanning frequency of from 2-100Hz in the y-axis and at a frequency of from 2-100Hz in the x-axis.